

II. CONTROL SYSTEM OPERATION: FT-3

A. Detailed Startup Sequence

1. Pre-Start Checklist

The following lists startup conditions that must be met to permit the automatic startup sequence of the flare:

- a. Master switch in the On position
- b. E-Stop button in the extended position
- c. Absence of any alarm conditions - The red flashing alarm beacon (located on top of the control panel) and the operator display will indicate if there are any alarm or fault conditions present. All fault conditions must be cleared to permit a start sequence.
- d. Inlet valve in the closed position
- e. Pilot temperature below the Blower-On setpoint
- f. Absence of any flame
- g. Control Mode switch in the Auto position

2. Ignition (Pilot) Cycle

The ignition cycle establishes an initial flame and heat source to generate adequate temperature prior to introducing the flow of landfill gas.

A pilot gas source, in conjunction with automatic spark ignition, is used to establish the initial flame. Propane is typically used for the pilot gas source.

The Ignition Timer setpoint is adjustable (typically 15 to 30 seconds.) A pilot thermocouple is used to monitor the pilot gas flame and is used to determine when to start the gas blowers (Blower-On setpoint) and open the header valve, allowing the flow of landfill gas. The pilot temperature measurement is also used to determine at what temperature (Pilot-Off setpoint) to discontinue the use of the pilot gas.

The Pilot Timer is used to indicate pilot system malfunction or failure and is user adjustable (typically 5 minutes.) If the pilot temperature does not reach the Pilot-Off setpoint before the Pilot Timer times out, a pilot fault will occur.

3. Combustion of Landfill Gas

Landfill gas is drawn from the landfill and sent into the flare stack for proper destruction using gas blowers.

Once adequate heat in the stack (for proper combustion) has been reached, determined by the measured pilot temperature, the gas blowers are started and the header valve is opened. This event is determined by the Blower-On setpoint (typically 300 °F) which can be adjusted to meet process requirements.

Blower startup and header valve position are monitored to ensure proper equipment operation. A blower auxiliary fault or header valve fault will occur if abnormal operation or positioning is detected.

After the combustion of landfill gas has begun, flame detection and low temperature detection are enabled.

4. Continuous Monitoring

Once the combustion of landfill gas has begun, certain conditions must be met to ensure proper combustion under safe operating conditions.

Ultra violet flame detection (UV eye) monitors the presence of a flame in the stack. In the event the flame is extinguished, the pilot ignition system will try to "re-ignite" the flame. Failure to re-ignite will result in a flame fault and the appropriate shutdown actions will occur.

The landfill gas flow, typically measured in standard cubic feet per minute (scfm), is also monitored, recorded, and displayed to indicate proper flare operation. High gas flow alarming is also in place to insure the gas flow does not exceed the capacity of the flare stack, which may result in an unsafe operating conditions and equipment damage.

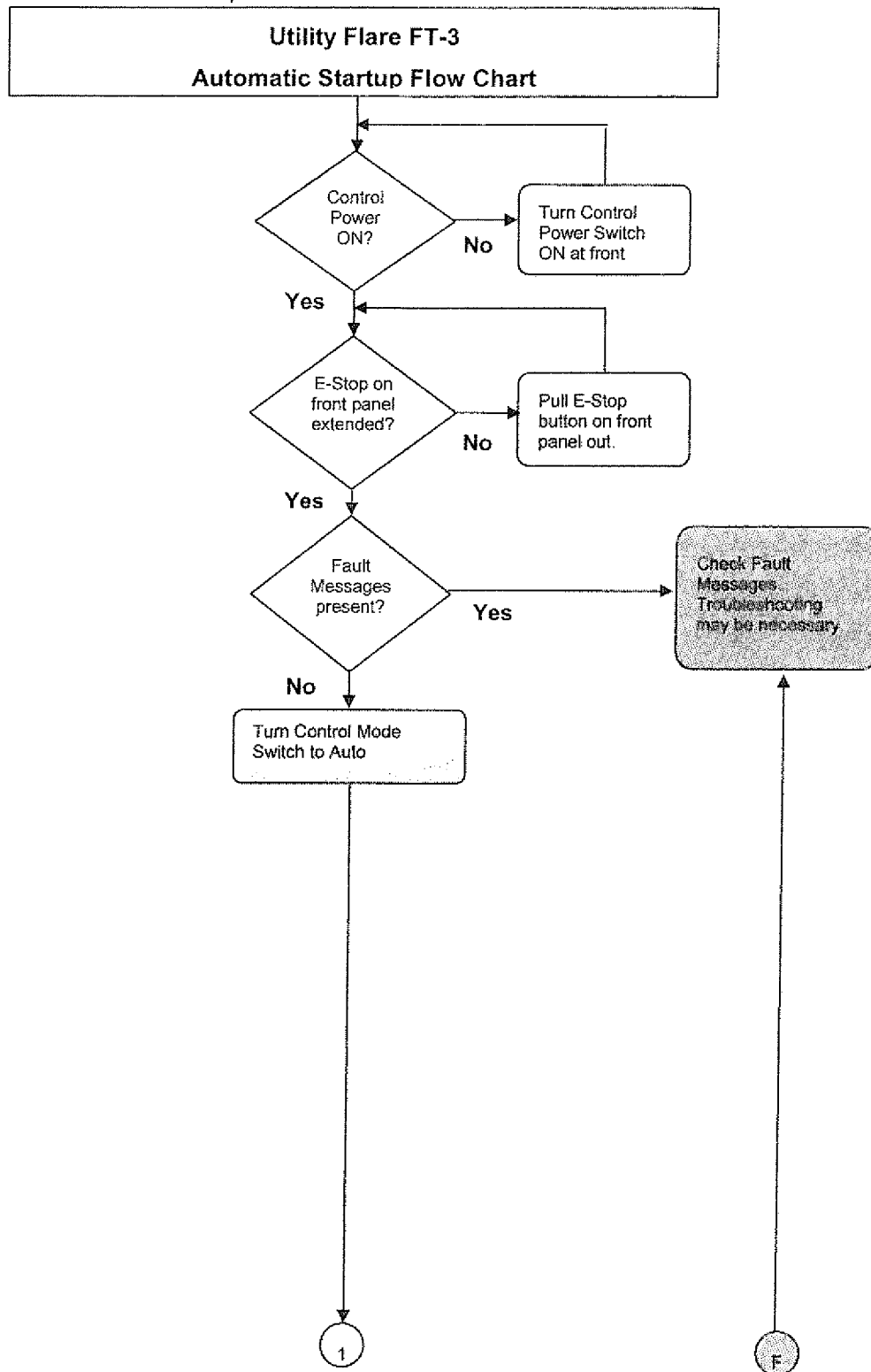
5. Automatic Re-start

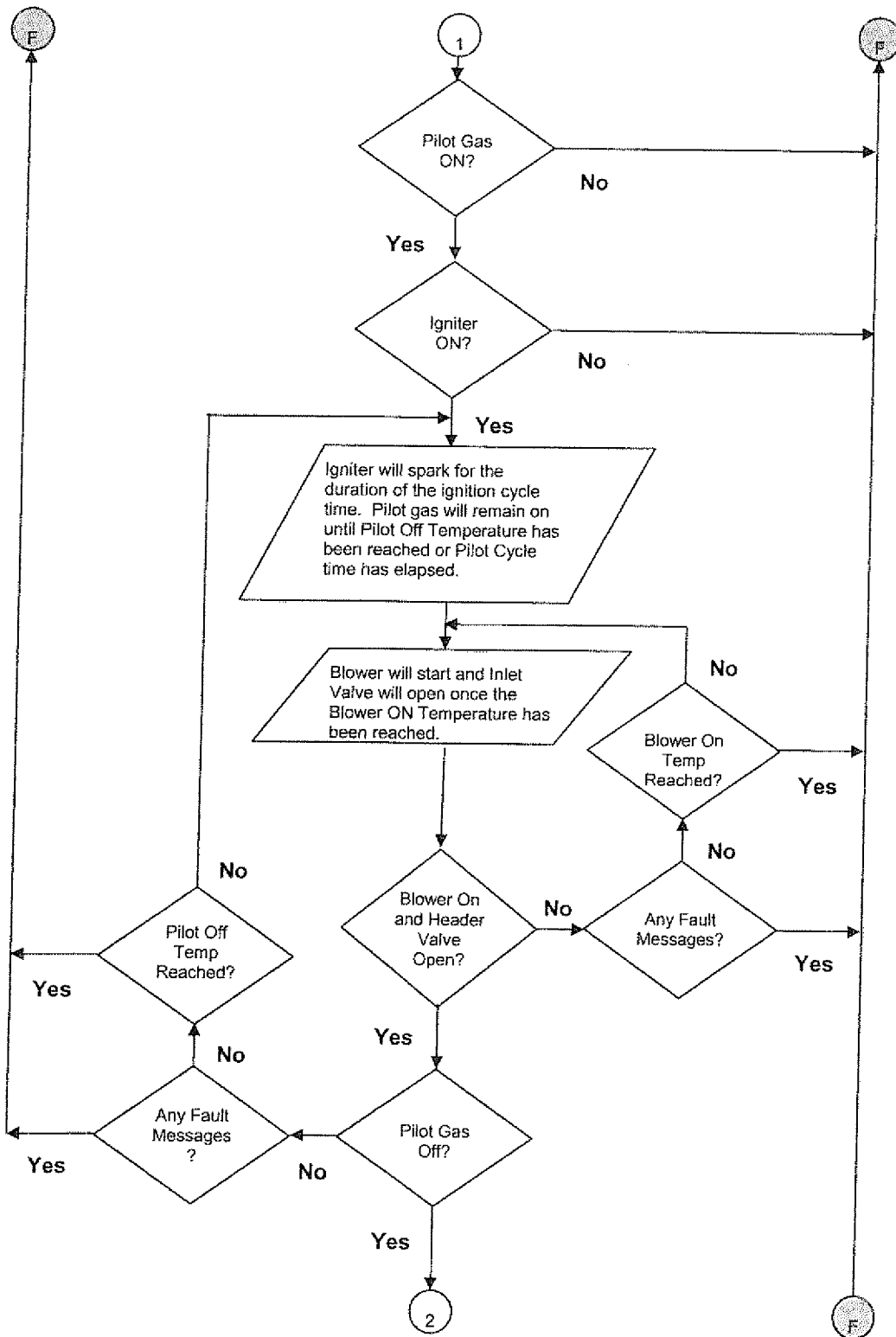
The flare will automatically attempt a re-start under the following fault conditions:

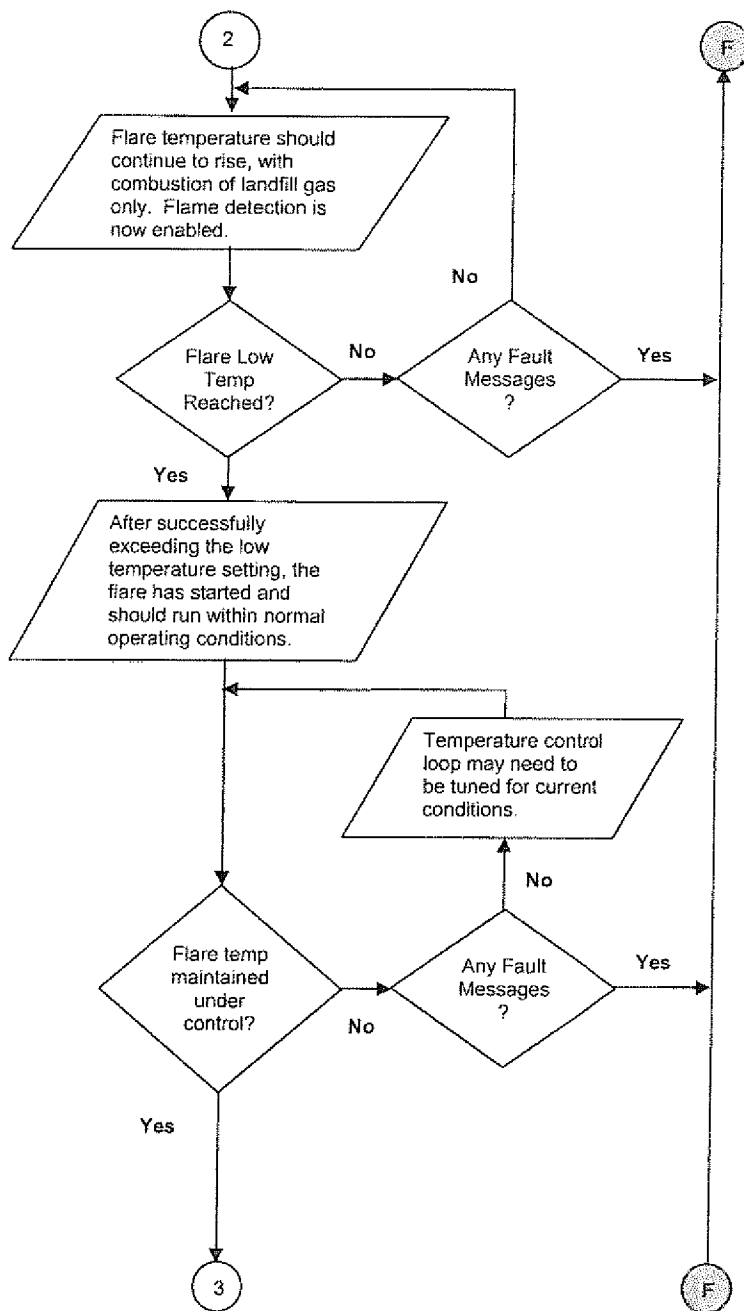
- a. Low temperature shutdown
- b. Flame failure shutdown
- c. Pilot Failure shutdown

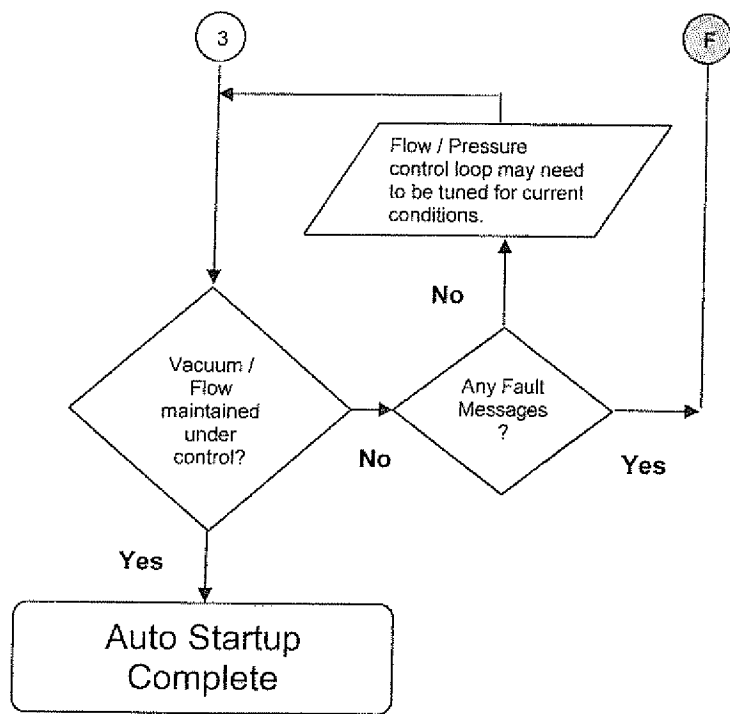
An automatic re-start will occur after the "Down Timer" has elapsed and the temperature has dropped to allow for a safe startup. A re-start consists of the same sequence of events as a typical startup, beginning with the purge cycle. A re-start limit, typically 3, is also used to limit the number of re-starts that can occur before a successful startup has been accomplished. If the number of restart attempts reaches the limit, the system will shutdown and operator attention is required.

Utility Flare FT-3 Automatic Startup Flow Chart



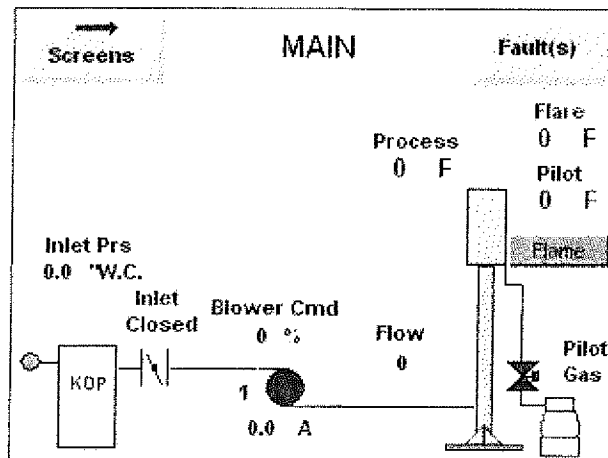






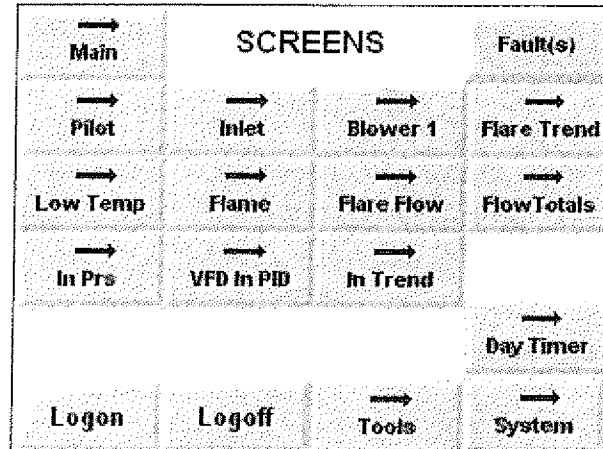
B. Operator Interface Operation and Screen Descriptions

1. MAIN



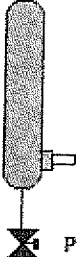
This operator screen is a general informative screen indicating the flare operation and process conditions.

2. SCREENS



This operator screen is simply a "Main Menu" of all the operator screens available. These pushbuttons will navigate to the configuration screen of interest.


3. PILOT

Screens	PILOT		Fault(#)
Pilot Cycle Time Setpoint		Ignition Time Setpoint	Temperature Setpoints
0.0 Min		0 Sec	Blower On
Actual		Actual	Pilot Off
0.0 Min		0 Sec	0 F
			Pilot Temp Actual
			0 F

This operator screen contains configuration input for the pilot / ignition cycle. The pilot cycle establishes an initial flame and heat source before igniting landfill gas.

- Pilot Cycle Time:** This time delay set point (min) is the amount of time allowed for measured pilot temperature to reach the "Pilot Off" temperature before a pilot fault will occur.
- Blower On:** This pilot temperature set point (deg F) determines when the landfill gas blower (s) will start.
- Pilot Off:** This pilot temperature set point (deg F) determines when the pilot cycle is complete.


4. INLET VALVE

Screens	INLET	Fault(s)
	<u>Setpoint</u>	
Fail Closed Fault Delay Setpoint	0 Sec	
	<u>Actual</u>	
 Open	0 Sec	
	<u>Setpoint</u>	
Fail Open Fault Delay Setpoint	0 Sec	
	<u>Actual</u>	
	0 Sec	

This operator screen contains configuration input for the landfill gas Inlet Valve. The inlet valve position is monitored with limit switches to insure proper operation.

- a. **Fail Open / Closed Delay Set point:** This time delay set point (sec) is the time allowed for the inlet valve to open or close, depending on commanded position, before an inlet valve fault will occur.

5. BLOWER X

Screens		BLOWER 1		Fault(s)	
Amp Fault Monitoring		H	M	Amps Scaling	
<u>Low Amp</u>	<u>High Amp</u>	0:00		<u>Raw</u>	
0.0 A	0.0 A	Blower		0	
		1 		<u>Minimum</u>	
Amp Fault Delay		Aux Timer	Sequence	0.0 A	
<u>Low Amp</u>	<u>High Amp</u>	<u>Setpoint</u>	<u>Timer</u>	<u>Maximum</u>	
0 Sec	0 Sec	0 Sec	0 Sec	0.0 A	
<u>Actual</u>	<u>Actual</u>	<u>Actual</u>	<u>Actual</u>	<u>Scaled</u>	
0 Sec	0 Sec	0 Sec	0 Sec	0.0 A	

This operator screen contains configuration input for the landfill gas blower (s). Each blower is controlled automatically and monitored to insure proper operation.

- Low / High Amp Fault Monitoring:** These set points refer to the blower running amperage. The blower running amperage should remain between the low and high set points for proper operation.
- Low / High Amp Fault Delay:** These time delay set points (sec) determine how long the blower running amperage can be outside of the defined limits, high or low, before a blower fault will occur.
- Aux Timer Set point:** This time delay set point (sec) is the time allowed for the blower to start when commanded to start. If the motor starter auxiliary contact does not provide feedback that the blower has started a blower fault and will occur.
- Sequence Timer Set point:** This time delay set point (sec) determines the time between blower start commands, when multiple blowers are used. This only applies when more than one blower will run at the same time.
- Amps Scaling:** These set points are used to adjust the controller instrumentation to match the blower current transmitters. These should only be adjusted at the factory or by qualified personnel.

6. INLET PRESSURE VFD PID

Screens		INLET PRESSURE VFD PID			Fault(s)
<u>Kp</u>	<u>Ki</u>	<u>Kd</u>	<u>Setpoint</u>	<u>Cv</u>	
0.00	0.000	0.00	-0.0	0	
<u>DB-</u>	<u>DB+</u>	<u>Slew</u>	0	<u>Pv</u>	
0	0	0		0	
				0.0	
<u>PID Mode Selection</u>	<u>PID Manual Command</u>				<u>PID Status</u>
Auto	0.0 %				PID Manual

This operator screen contains configuration input for the inlet pressure / vacuum control loop. By varying the blower speeds using variable frequency drives (vfd's), a steady controlled vacuum can be maintained at the inlet of the flare equipment. This results in a constant, steady vacuum being applied to the landfill. The Pv (process variable) represents the measured vacuum. The Cv (control variable) represents the speed command being given to the blower (s).

- Kp, Ki, Kd:** These settings are proportional gain, integral, and derivative tuning parameters. These settings determine the responsiveness of the controller to the process and should only be adjusted by qualified personnel.
- DB-, DB+:** These settings are the positive and negative dead band set points. These affect how the controller responds to a process deviation from set point and should only be adjusted by qualified personnel.
- Slew:** This time setting (sec) affects the responsiveness of the controller to the process and should only be adjusted by qualified personnel.
- Setpoint:** This setpoint (- IWC) is the desired inlet vacuum. The controller will control and maintain this value.
- PID Manual Command:** This is the controller output command (0 – 100%) when the control loop is put in manual mode. 0 to 100% represents zero to maximum blower speed.
- PID Mode Selection:** This button allows the operator to switch the controller mode from automatic to manual operation. While in automatic mode, the controller will maintain the desired set point. When in manual mode the controller output will be fixed at the value entered for the PID manual command.

7. INLET PRESSURE

Screens	INLET PRESSURE	Fault(s)
High Vacuum Fault	Pressure Scaling	
<u>Setpoint</u>	<u>Raw</u>	
0.0 "W.C.	0	
	<u>Minimum</u>	
<u>Fault Delay</u>	0.0	
0 Sec	<u>Maximum</u>	
<u>Actual</u>	0.0	
0 Sec	<u>Scaled</u>	
	0.0 "W.C.	

This operator screen contains configuration input for the flare inlet vacuum transmitter. The vacuum transmitter measures the amount of vacuum (- IWC) at the inlet of the flare equipment.

- High Vacuum Fault Set point:** This set point (IWC) is the fault set point for the measured vacuum at the inlet to the flare.
- Fault Delay:** This time delay set point (sec) determines how long the measured vacuum can exceed the high set point before a vacuum fault will occur.
- Pressure Scaling:** These set points are used to adjust the controller instrumentation to match the vacuum transmitter. These should only be adjusted at the factory or by qualified personnel.

8. FLARE FLOW

Screens	FLARE FLOW	Fault(s)
High Flow Fault		Flow Scaling
<u>Setpoint</u>		<u>Raw</u>
0		0
		<u>Minimum</u>
		0
<u>Fault Delay</u>		<u>Maximum</u>
0 Sec		4000
<u>Actual</u>		<u>Scaled</u>
0 Sec		0 SCFM

This operator screen contains configuration input for landfill gas flow monitoring. The flow meter measures gas flow in standard cubic feet per minute (SCFM). Monitoring for high flow insures the gas flow does not exceed the limits of the flare stack.

- High Flow Set point:** This flow set point (scfm) is the high flow limit allowed before exceeding the capacity of the flare stack, resulting in a high flow fault.
- Fault Delay:** This time delay set point (sec) determines how long the measured flow can exceed the high flow set point before a high flow fault will occur.
- Flow Scaling:** These set points are used to adjust the controller instrumentation to match the flow meter calibrated range. These should only be adjusted at the factory or by qualified personnel.

9. FLOW TOTALS

Screens		FLOW TOTALS		Fault(s)	
<u>Lifetime Totals</u>					
0	SCF				
0	SCF per K				
<u>Resettable Totals</u>					
0	SCF				
0	SCF per K				
RESET					

This operator screen contains the measured total gas flow. The lifetime totals indicate total flow from when the flare was initially started. Lifetime totals cannot be reset. Resettable totals can be reset by the operator and the accumulated total will reset to zero.

10. LOW TEMP

Screens		LOW TEMP		Fault(s)	
Temp Setpoints			Fault Delays		
Low Temp Setpoint	Reset Temp Setpoint	Start Delay Setpoint	ShutDown Delay Setpoint		
0 F	0 F	0.0 Min	0.0 Min		
Actual		Actual	Actual		
2500 F		0.0 Min	0.0 Min		

This operator screen contains configuration input for low temperature monitoring. To insure proper landfill gas combustion, the proper temperature must be maintained. If the temperature cannot be maintained, a low temperature fault will occur, resulting in a flare shutdown.

- Low Temp Set point:** This temperature set point (deg F) determines when a low temperature condition exists, resulting in a low temperature fault.
- Reset Temp Set point:** If the temperature drops below the low temperature set point (deg F), resulting in a low temperature condition, it must then rise above this set point to clear the fault condition.
- Start Delay Set point:** This time delay set point (min) is the time allowed, during initial flare startup, for the temperature to rise above the low temperature set point.
- Shutdown Delay Set point:** This time delay set point (min) is the delay before a shutdown will occur if the temperature drops below the low temperature set point.

11. FLAME DETECTION

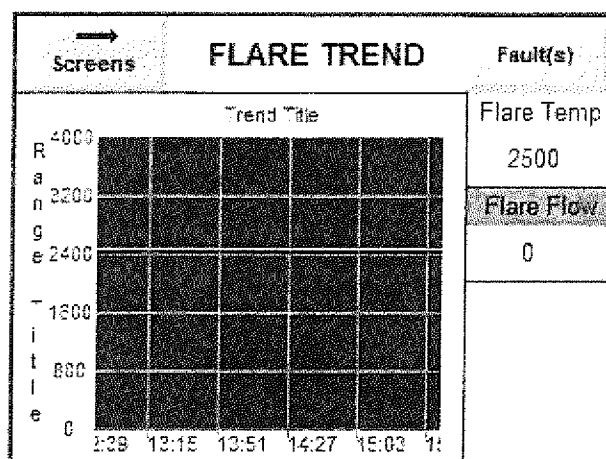
Screens		FLAME DETECTION		Fault(s)	
Flame Fault Delay Setpoint		Relight Cycle Setpoint		Flame Test Timer Setpoint	
0 Sec		0 Sec		0 Sec	
Actual		Actual		Actual	
0 Sec		0 Sec		0 Sec	
Flame Detect On					

This operator screen contains configuration input for flame detection. Monitoring for the presence of flame is another method of insuring proper landfill gas combustion. An ultraviolet (UV) detector is used for this function. If the flame is lost, a re-light cycle will re-ignite the pilot system in an attempt to re-establish proper combustion. If unsuccessful, a flame fault will occur.

- Flame Fault Delay Set point:** This time delay set point (sec) is delay before a flame fault will occur, if the flame is lost.
- Relight Cycle Set point:** This time set point (sec) is the amount of time the pilot gas system will be used in an attempt to re-ignite the flare, after the flame has been lost.
- Flame Test Timer Set point:** After a "re-light" cycle has occurred, a flame check is done after this time delay (sec) has elapsed.
- Flame Detect On:** This button will enable or disable flame detection. The text label on the button will indicate "Flame Detect On", or "Flame Detect Off."

Note: Flame detection should only be disabled in the event the flame detection instrumentation is not functioning properly and in need of replacement.

12. FLARE TREND



This operator screen contains a graphical trend indicating flare temperature and measured gas flow. This screen does not contain user configurable settings, but shows a brief history of the flare operating conditions.

13. TIME OF DAY OPERATION

Screens		TIME OF DAY OPERATION		Fault(s)	
		Hour : Min			
		Actual	15 : 48		
Active		Start	8	30	
Flare Idle		Stop	16	30	
DAY OF WEEK					
Sun	Mon	Tue	Wed	Thu	Fri Sat

This operator screen contains configuration input for the day timer function. Flare operation can be scheduled to run during a specific time of day and on specific days of the week.

- Active:** This button is used to enable or disable the day timer function. If disabled the flare is permitted to run continuously. The text label on the button will indicate "DISABLED" or "ACTIVE."
- Actual / Start / Stop:** These time indicators show the actual time, the flare start time, and the flare stop time. The desired start and stop time (hr : min) are entered in military (24 hr) time.
- DAY OF WEEK:** These buttons are used to select the days in which the flare should operate. A button color of GREEN indicates an active day, RED, indicates an inactive day.

14. SYSTEM

Screens		SYSTEM		Fault(s)
Down Timer Setpoint	Restart Counter Setpoint	Auto Reset Timer Setpoint	Maximum Manual Operation Setpoint	
10 Min	3	15 Sec	240 Min	
Actual 0 Min	Actual 0	Actual 0 Sec	Actual 0 Min	
User: operator		Access: 10		Default SP's

This operator screen contains configuration input for general system settings.

- a. **Down Timer Set point:** This time delay set point (min) is the time that must elapse before an automatic re-start will occur. An automatic restart is initiated after the following faults occur:
 - 1) Pilot Fault
 - 2) Low Temperature Fault
 - 3) Flame Fault
- b. **Restart Counter Set point:** This value indicates the number of automatic re-starts permitted before a system shutdown will occur.
- c. **Auto Reset Timer Set point:** This time delay set point (sec) determines how long an automatic reset occurs during initial power up of the control system. This allow for all instrumentation to proper power up before initiating a flare start up.
- d. **Maximum Manual Operation Timer Set point:** This is the maximum time (min) in which the flare can be operated in manual mode.
- e. **Default SP's:** This button will only appear if the user is logged in as "operator." This will go to the next screen, DEFAULT SET POINTS, and allow the operator to restore all user adjustable set points to the "factory defaults."

15. DEFAULT SET POINTS

Screens	DEFAULT SET POINTS	Fault(s)
Restore will overwrite current Setpoints with the backup Setpoints		
Restore Setpoints		
User: operator Access: 10		

This operator screen allows the operator to restore all user adjustable set points to the "factory defaults."

16. RUNTIME TOOLS

